

Remember they were emotional - effects of emotional qualifiers during sentence processing

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Research Article

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Remember they were emotional - Effects of emotional qualifiers during sentence processing

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Abstract: We investigated whether emotional information facilitates retrieval and whether it makes representations more salient during sentence processing. Participants were presented with sentences including entities (nouns) that were either bare, with no additional information or that were emotionally or neutrally qualified by means of adjectives. Reading times in different word regions, specifically at the region following the verb where retrieval processes are measurable, were analysed. Qualified representations needed longer time to be build up than bare representations. Also, it was found that the amount of information and the type of information affect sentences processing and more specifically retrieval. In particular, retrieval for emotionally specified representations was faster than that for bare representations.

Keywords: sentence processing, retrieval, emotion, information load

Introduction

Can you remember an *angry politician* better than a *small politician*? Previous studies have focused on whether the amount of information that is associated with an entity can improve its recall from memory (Hofmeister, 2011). In contrast to this body of research, our study asks the question whether *the type* (rather than the amount) of information that is provided in connection with an entity is similarly important to consider when accessing information for recall.

When we read, we form mental representations of the situations and characters presented within a text or sentence (Glenberg & Langston, 1992; Zwaan, Magliano & Graesser, 1995). These situational representations contain a number of features provided by the linguistic context. Each representation is linked to a certain set of features (associations). Based on the amount of information associated with an entity, the representation can be either rich or weak in memory (Hofmeister, 2011). Rich representations are linked to a large set of features. Weak or bare representations are linked to a smaller set of features.

Research on sentence processing has found that the *amount* of features associated with an entity is relevant for recall. For example, Hofmeister (2011) gave evidence that semantically rich concepts, i.e. concepts for which a lot of information is provided, are more easily recalled than items for which there is no contextual information. In this study, cleft sentences were used to monitor facilitated retrieval processes for complex (semantically rich) noun phrases (see example 2.1). Noun-phrases were simple or more complex in structure in which they were presented with either no, one, or two qualifying adjectives:

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Example 1:

simple: It was a communist (i) who the members of the club banned (i) from ever entering the premises.

mid: It was an alleged communist (i) who the members of the club banned (i) from ever entering the premises.

complex: It was an alleged Venezuelan communist (i) who the members of the club banned (i) from ever entering the premises. (Hofmeister, 2011)

Sentences included long-distant dependencies in order to highlight retrieval effects after the verb (*banned* in this example). During reading, sentence components have to be analysed and related to one another. In the examples above, a cleft after the verb (i) must be identified as a reference point to the prior noun phrase. Therefore, the noun (e.g. *the communist* in Example 1) has to be kept in memory until it can be integrated as the object of the verb phrase (e.g. *banned*). For the experiment, retrieval times at the critical region after the verb as well as for the initial noun phrases were measured. In Hofmeister's (2011) study, two or one adjective(s) preceded the noun. Findings revealed a linear relationship of reading time to complexity, with proportionally faster reading times for the region following the verb for each adjective qualifying the noun (i.e. for mid and complex conditions). This finding shows that a rich semantic context leads to a more elaborated, more salient representation in memory and hence to faster re-activation rates and faster integration. In the current study, we use a very similar design to Hofmeister (2011) and look at whether recall and the salience of the representations differ between non-qualified, qualified and strongly qualified nouns. The focus of our study is, however, whether the recall of the nouns and the salience of their representations depend on the *type* of information that is linked to them.

Our study builds on Hofmeister's findings and aims to explore whether the salience of a representation can be enhanced not only by providing more information about the entity, but by making the information itself more salient. Emotions in particular have been identified as important for building mental representations (Gygax, Oakhill & Garnham 2003; Zwaan, 1999; de Vega, León & Diaz, 1996; Kneepkens & Zwaan, 1995; Graesser, Singer & Trabasso 1994; Gernsbacher, Goldsmith & Robertson 1992). Gernsbacher et al. (1992) found that emotional features are mentally represented and incorporated into the overall context during reading. It is argued (Mar, Oatley, Dijkic & Mullin, 2011) that readers engage more with a text when they read about a character's emotions, as they are able to identify or sympathise with the character's emotional state. Graesser et al. (1994) argue that the emotional state of characters is interpreted during the reading process and that emotional states help to establish global coherence within the text. As argued by Zwaan (1999), emotional information is closely related to the characters' goals (their motivations) (e.g. a character is happy when successfully achieving a goal, for example getting a promotion). Hence, emotions link events (the character being promoted and the character being happy) in a text and provide explanations for the characters' actions and behaviours later in the text (the character organises a celebration party). Also, readers are able to spot emotional inconsistencies within the text (e.g. if following their success, the character is described as *upset*, Gernbacher, Hallada & Robertson, 1998; Gygax et al., 2003). These emotional inconsistencies have been found to cause processing problems as the new information cannot be easily integrated with the existing representation (of a successful and happy character). We believe that emotional information helps readers to build up a more coherent and more engaging mental representation. Based on this idea, we suggest that representations that include emotional information are more salient and more easily retrieved.

Our study aims to show that representations including emotional information are more salient than those including neutral information and that, therefore, emotions can facilitate retrieval processes. Previous research has highlighted the role of emotions for word, morpho-syntactic and sentence processing (Hinojosa, Albert, Fernández-Folgueiras, Santaniello, López-Bachiller, Sebastián, Sánchez-Carmona & Pozo, 2014; Scott, O'Donnell & Sereno, 2012; Schacht & Sommer, 2009); however, there is little research focusing on the *retrieval* of emotionally qualified entities. Researchers so far have found that emotion words affect and facilitate lexical access (Scott, O'Donnell & Sereno, 2012) as well as morpho-syntactic processing (Hinojosa et al., 2014). The effects of emotions have also been studied using ERP recordings and they give the evidence of predominantly early effects of (in particular positive) emotions on processing (Díaz-Lago, Fraga & Acuña-

Fariña, 2015; Schacht & Sommer, 2009). Importantly, previous studies have found evidence that emotional valence and arousal can affect syntactic processing (Fraga, Piñeiro, Acuña-Fariña, Redondo, & García-Orza, 2012). In a series of experiments, Kensinger & Corkin (2003) found evidence for improved word-recall of emotional (especially negative) rather than neutral words. They found that negative emotion words led to more detailed (more vivid) recall than neutral words and suggest a qualitative benefit for emotion words during recall. There is clear evidence that emotions play an interesting role during processing and recall; however, there is (to our knowledge) no evidence that emotions affect retrieval during syntactic processing.

Our study adds to this large body of research investigating effects of emotions on processing and we aim to show that emotional features affect the retrieval of their associated entities. As predicted by cue-based retrieval models (Van Dyke & Lewis, 2003), the presence of semantic features facilitates retrieval processes. Thus, it can be predicted that the prioritisation of certain (i.e. emotional) semantic features over other (i.e. non-emotional) features affect memory performance and lexical access during sentence comprehension. Quite frequently, entities share a lot of semantic features and, even if their representation is unique, they can have a great overlap with regard to their associations in memory. This overlap makes their identification in memory, i.e. their retrieval, more difficult (Gordon, Hendrick, Johnson & Lee, 2006). By contrast, entities with a higher number of features and more unique or more salient features lead to faster and easier retrieval (Traxler, Morris, & Seely, 2002). In our experiment, we investigated whether emotional information causes representations to be more salient and unique in memory and therefore we predict that retrieval for representations that include emotional features is facilitated.

The study adds to and brings together research on emotional effects on processing and research on information retrieval during sentence processing. We test whether emotional representations containing emotional features are more easily retrieved than neutral representations or representations without additional information. Therefore, in our experiment, we will present sentences similar to the ones used by Hofmeister (2011). As predicted by researchers investigating brain-activations during cognitive processing, a high cognitive load has a *downregulating* impact on emotion processing (Erk, Kleczar & Walter, 2007) hence in our study we also manipulate the information load, similarly as in the study by Hofmeister (2011). Therefore, sentences contain a noun that is either bare or qualified (with features characterising the representation of its referent). Building on Hofmeister's (2011) design, we add a condition in which one of the qualifiers is of an emotional type, i.e. provides emotional information about the person mentioned. For sentences including two qualifiers, only one is emotional for the emotional condition. The second one is emotionally neutral and the same as in the non-emotional condition. This design allows us to investigate whether processing and the processing of emotional information is affected by the amount of information, i.e. by the information load, which would be reflected in generally faster recall for more qualified nouns (Hofmeister, 2011) and in a reduced effect of emotions for the high load condition (Erk et al., 2007). Hence, we predict that emotional information causes representations to be more salient, and hence, retrieval for emotionally qualified nouns should be faster than for non-emotionally qualified entities, but this effect may be affected by the cognitive load (the amount of qualifiers). If results are in line with Hofmeister (2011), (i) nouns including two qualifiers (high information load) will be retrieved with greater ease than nouns with fewer qualifiers (mid information load or bare). Moreover, (ii) emotionally qualified entities should be retrieved faster than non-emotional entities, but (iii) this effect might be attenuated for high load entities.

Method

Participants

Seventy-two individuals (58 females) were recruited to participate in the study. Data sets for three individuals had to be removed because of technical problems. All participants were blind to the purpose and subject of the study. Moreover, all participants were recruited at the University of Sussex and indicated a comparably high level of education. Only native speakers of English were tested. None of the participants reported or showed signs of a reading disorder. The age range was from 18–42 years, with $M = 23.25$, $SD = 6.61$.

Items

Twenty-four critical items were generated in three different conditions, including different levels of semantic information:

Example 2

bare: *It was a writer that the dignitaries at the ceremony awarded with a medal in Stockholm.*

emotional: *It was an optimistic (English) writer that the dignitaries at the ceremony awarded with a medal in Stockholm.*

non-emotional: *It was a reclusive (English) writer that the dignitaries at the ceremony awarded with a medal in Stockholm.*

For the first condition (bare), the first noun phrase was not preceded by any adjectives (see Example 2). For all other conditions, nouns were preceded by either one or two adjectives (mid information load and high information load). For the emotional conditions, one emotional adjective qualified the noun, which was followed by a non-emotional adjective for the high load condition, in which two adjectives were included (we refrained from including two emotional qualifiers as characters usually only experience one emotional state at a time). Emotion words were taken or derived from Johnson-Laird and Oatley's (1989) emotion word list. The authors present emotions that are semantically related to one of the five basic emotional experiences (*happiness, sadness, anger, fear, disgust*; Johnson-Laird & Oatley, 1989, p. 107). For the non-emotional conditions, we chose adjectives that were not denoted as emotional and that were not included in the emotion list provided by Johnson-Laird and Oatley (1989), hence, only emotionally neutral qualifiers (one or two) preceded the noun. The emotion word corpus was also suggested by Pavlenko (2008) who highlight a distinction between emotion words and emotion-laden words. We refrained from using emotion-laden words as defined and categorised by Pavlenko (2008, p. 148) as "words that do not refer to emotions directly but instead express (*jerk, loser*) or elicit emotions from the interlocutors (*cancer, malignancy*). The following subcategories are commonly differentiated among emotion-laden words: (a) taboo and swearwords or expletives (*piss, shit*), (b) insults (*idiot, creep*), (c) (childhood) reprimands (*behave, stop*), (d) endearments (*darling, honey*), (e) aversive words (*spider, death*), and (f) interjections (*yuk, ouch*)". Items for the bare and the two non-emotional conditions were taken over from Hofmeister's experiment (2011).

We analysed whether sentence length differed as a function of a condition. As it can be assumed, length differed with respect to whether one or two adjectives were included in a sentence (95% *CI* [-199.48 – -83.00], $p < 0.001$). Also, the bare condition (with no adjective included) differed from the conditions that included qualifiers (bare vs emotional: 95% *CI* [71.36–240.35], $p < 0.001$; bare vs non-emotional: 95% *CI* [84.59–253.58], $p < 0.001$), however, importantly, the length did not differ between emotional and non-emotional conditions (95% *CI* [-71.27–97.73], $p > 0.1$).

In order to disguise the experiment's purpose, 32 filler items were added to each list. The 56 items presented to each participant were showed in a random order that was different for each participant.

Design

We created five conditions accounting for information type (emotional/non-emotional) and information load (bare/high load and mid load). Hence the five conditions were: 1. Bare, 2. Emotional/High load, 3. Non-emotional/High load, 4. Emotional/Mid load and 5. Non-emotional/Mid load. Three lists were created, in line with a Latin Square Design, for each information load set (high or mid load). Hence, three out of the six created lists contained bare items, plus qualified conditions with two adjectives (the high load set, i.e. 1, 2, 3) and three contained bare items plus qualified conditions with one adjective (the mid load set, 1, 4, 5). Each sentence was included in only one condition (bare, emotional or non-emotional; with eight items of each information type per list). We measured reading times for each word in each sentence. In addition, we recorded answers for comprehension questions as our accuracy measure.

Word/Sentence ratings

The adjectives we used in our items were rated for their concreteness, imageability, and their frequency. Concreteness and frequency scores for each adjective were obtained with the use of the MRC psycholinguistic database (Coltheart, 1981; http://websites.psychology.uwa.edu.au/school/MRCDatabase/uwa_mrc.htm; we could not obtain frequency scores for seven adjectives). Ratings for imageability were obtained in an online survey conducted with the use of Mechanical Turk (MTurk, <https://www.mturk.com/>). Imageability ratings were given on a 5-point scale from 1 (e.g. *not imageable*) to 5 (e.g. *very imageable*). We compared imageability, concreteness and frequency scores for adjectives in the emotional and non-emotional conditions using t-tests (see Table 1 for means). We found that imageability ratings did not differ between emotional and non-emotional adjectives ($p > 0.1$). For imageability scores Cronbach's alpha was 0.99 on a 48-item-scale.

For frequency, it was found that frequency scores were higher for non-emotional adjectives (i.e. the non-emotional adjectives that were used in this study can be more frequently found in texts) than for emotional adjectives ($t(39) = 2.03$, $p = 0.049$). For frequency scores, Cronbach's alpha was 0.96 on a 41-item-scale. Due to these frequency differences between emotional and non-emotional adjectives and due to the notion that frequency affects processing latencies especially for recall (van Gompel & Majid, 2004), we included frequency as a covariate fixed factor into our analyses (the LMMs). We found no effect of frequency on reading times (for the noun-phrase: $\beta = 0.00$, $SE = 0.00$, $t(240) = 0.67$, $p > 0.1$; for the region following a noun: $\beta = 0.00$, $SE = 0.00$, $t(108) = 0.26$, $p > 0.1$; for a verb-phrase: $\beta = 0.00$, $SE = 0.00$, $t(121) = 0.02$, $p > 0.1$ and for the region following a verb: $\beta = 0.00$, $SE = 0.00$, $t(299) = 0.05$, $p > 0.1$).

Concreteness scores were not affected by information type ($p > 0.1$). For concreteness scores Cronbach's alpha was 0.99 on a 48-item-scale.

Table 1. Mean ratings for imageability, frequency and concreteness for qualifiers

	Emotional adjectives		Non-emotional adjectives	
	Mean	SD	Mean	SD
Imageability	-0.06	0.85	-0.07	0.96
Frequency	15.58	17.9	56.73	86.61
Concreteness	2.07	0.32	2.27	0.47

We include valence and arousal ratings (see Table 2a) for emotion words, taken from the database provided by Warriner, Kuperman and Brysbaert (2013). For ratings concerning the non-emotional words see Table 2b in the appendix (Warriner, Kuperman and Brysbaert, 2013). Among the twenty-four emotional qualifiers, we could not obtain valence and arousal data for two adjectives (*miffed* and *unperturbed*), however it is perceivable that *miffed* denotes a negative and *unperturbed* a positive emotion. As we had no particular hypotheses about valence, we did not counterbalance for valence and, in fact, nine adjectives were identified as positively valenced (with $M > 5.00$, plus *unperturbed*) and fifteen adjectives were perceived as negative (with $M < 5.00$, plus *miffed*). Because different adjectives were included (load conditions) or excluded (bare condition) in different lists, positively and negatively valenced items were not equally represented in the different lists. Arousal ratings were not affected by valence (positive: $M = 4.45$, $SD = 1.42$, or negative: $M = 4.87$, $SD = 1.15$; $t(20) = 0.74$, $p = 0.47$).

Moreover, in another Mechanical Turk survey we asked individuals to rate the whole experimental sentences for whether they seemed natural. Ratings were given on a 5-point-scale from 1 (e.g. *not natural*) to 5 (e.g. *very natural*). ANOVA was used to compare sentence ratings across emotion type conditions. Ratings on complete sentences were not affected by the conditions ($p > 0.1$). Cronbach's alpha was 0.94 on the 72-item-scale.

Table 2a. Valence and arousal ratings for emotional qualifiers

Emotional qualifiers	Mean valence rating	Mean arousal rating
<i>bewildered</i>	4.32	4.57
<i>delighted</i>	7.74	5
<i>desolate</i>	2.95	3.22
<i>devoted</i>	7.16	4.22
<i>embarrassed</i>	3.51	5.38
<i>emotional</i>	5.11	1.79
<i>fascinated</i>	7	6.1
<i>fearless</i>	5.81	4.05
<i>furious</i>	2.57	6.09
<i>horrified</i>	2.68	6.29
<i>jealous</i>	2.38	5.9
<i>lovesick</i>	3.63	5.81
<i>melancholic</i>	3.74	4.13
<i>miffed</i>	NA	NA
<i>moody</i>	3.71	5
<i>mournful</i>	3.32	2.78
<i>nervous</i>	3.56	5.51
<i>optimistic</i>	7.45	4.19
<i>paralysed</i>	2.52	4.47
<i>passionate</i>	7.17	6.33
<i>satisfied</i>	7.16	3.95
<i>startled</i>	4.53	5.67
<i>sulky</i>	3.22	3.3
<i>unperturbed</i>	NA	NA

Procedure

Items were presented with the use of the computer software E-Prime 2 (Schneider, Eschman & Zuccolotto, 2012). Participants were tested in a self-paced reading paradigm. Following Hofmeister (2011), after three practice trials, sentences were displayed word by word on a computer screen (Dell, 17-inches). Responses were given through a button-box, and reading times for each word were recorded. A comprehension question followed each sentence (in order to ensure that participants attended to the task, they were asked to answer as fast as possible). Participants were asked to answer either “YES” or “NO” on the button box. Once an answer was, the next trial started, indicated by a cross, displayed on the screen.

Results

The data were analysed by regions of interest, i.e. the head noun (e.g. Ex. 2, *writer*), the word after the noun phrase (e.g. Ex. 2, *that*), the verb (e.g. Ex. 2, *awarded*) and the word after the verb (e.g. Ex. 2, *with*). Reading times were transformed with a natural logarithmic transformation in order to counteract a negative skew. We excluded outliers for each region separately, defined as data points more than 2.5 standard deviations away from the mean per condition (Fedorenko, Gibson & Rohde, 2007). For the region of the noun-phrase,

we excluded 1.88%; 1.88% for the region after the noun; 2.55% for the verb-phrase region and 2.52% for the region after the verb phrase. We also included data from only those trials which were followed by correctly answered comprehension questions (as in Hofmeister, 2011). In order to account for reading time differences based on word-length effects, logarithmic reading times were residualised (using regressions by participant, again for each region separately) (Fedorenko et al., 2007). We applied linear mixed modelling for the main analysis using R and the package lme4 (Bates, Maechler, Bolker & Walker, 2015), with the default restricted maximum likelihood estimations (R Studio Team, 2015). In addition, to obtain probability values, we used the Satterwaite approximation from the lmeTest package (Kuznetsova, Brockhoff & Christensen, 2015). Model fit was evaluated using scree plots of Principal Component Analyses produced by the RePsychLing package (Baayen, Bates, Kliegl & Vasishth, 2015) and the Akaike Information Criterion (AIC, Bates, 2010). We report models that were not subject to convergence issues or overfitting (Bates, Kliegl, Vasishth & Baayen, 2015), and that generated the lowest AIC scores. As the fixed effect, we included or-conditions (bare, emotional/high load, non-emotional/high load, emotional/mid load and non-emotional/mid load). The lsmeans package (Length, 2016) was used for pairwise comparisons and means for log reading times are reported. We included random intercepts¹ and slopes for participants and items. Tables were generated using the sjPlot package (Lüdtke, 2018).

Reading times for the head noun (NP, e.g. writer)

First, reading time effects were analysed for the region of the initial head noun. In four of the five conditions the noun was preceded by two or one qualifier(s) (e.g. *English*).

Table 3. LMM coefficients and effects for information type (no information, emotional, non-emotional) and number of adjectives (either one or two) on reading times at NP

	Residuals		
	<i>B</i>	<i>CI</i>	<i>p</i>
Fixed parts			
(Intercept)	-0.01	-0.05–0.02	.434
Emotional/High load	0.07	0.02–0.12	.007
Non-Emotional/High load	0.01	-0.04–0.06	.670
Emotional/Mid load	0.02	-0.04–0.07	.544
Non-Emotional/Mid load	-0.01	-0.06–0.04	.667
Random parts			
σ^2		0.100	
$\tau_{00, \text{Part}}$		0.000	
$\tau_{00, \text{Ex}}$		0.002	
N_{Part}		38	
N_{Exp}		24	
ICC_{Part}		0.000	
ICC_{Exp}		0.023	
Observations		1360	
R^2 / Ω_0^2		.043 / .038	

As it can be seen in Table 3, only the emotion/high load condition ($M = 547$, $SD = 280$) differed from the bare condition ($M = 512$, $SD = 288$) with longer reading times for the emotion/high load condition. Contrasts revealed that the emotion/high load condition also differed from the non-emotion/high load condition (M

¹ Because of known, and unresolved, problems in the reporting of parameter estimates for lmer models with no random intercepts (see Walker, 2014; Bolker, 2013), we focused on models that included random intercepts. For the RT data estimates of the variability of the intercepts for participants were correct at 0.

= 501, $SD = 207$). These effects were not evident for the emotion/mid load condition. Emotional/mid load ($M = 526$, $SD = 187$) and non-emotional/mid load conditions ($M = 514$, $SD = 181$) did not differ from another or with regard to the bare condition. Figure 1 displays (log) residual reading times for all conditions.

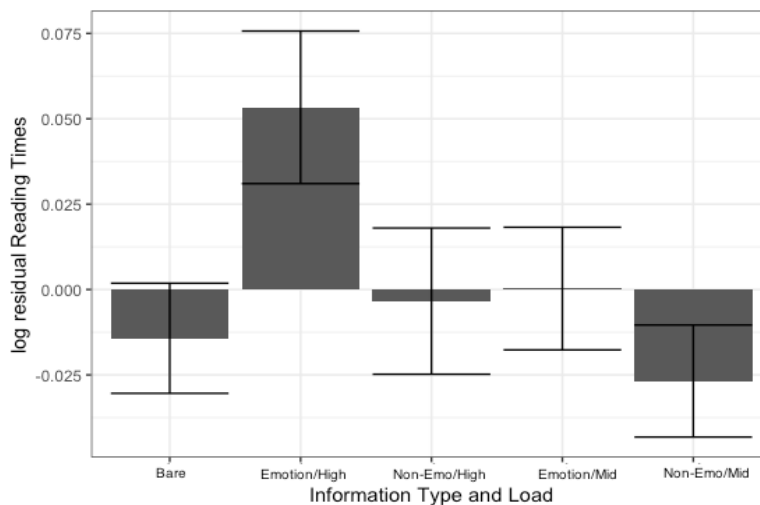


Figure 1. Reading times for bare nouns and qualified (emotionally or non-emotionally) nouns in mid or high load conditions at NP region

Reading times for that (the region after the NP)

In line with the results reported by Hofmeister 2011 (Experiment 1), we also found complexity effects as a spill over after the noun phrase (Table 4). We predicted that qualified nouns lead to slower encoding (Hofmeister, 2011), hence we used one-tailed t-tests for comparisons.

Table 4. LMM coefficients and effects of information type (no information, emotional, non-emotional) and information load (either one or two) on reading times at that (NP + 1)

	Residuals		
	<i>B</i>	<i>CI</i>	<i>p</i>
Fixed parts			
(Intercept)	-0.06	-0.09 – -0.02	.002
Emotional/High load	0.09	0.04–0.15	<.001
Non-Emotional/High load	0.07	0.02–0.13	.005
Emotional/Mid load	0.07	0.01–0.12	.018
Non-Emotional/Mid load	0.10	0.04–0.15	<.001
Random parts			
σ^2		0.117	
$\tau_{00, \text{Part}}$		0.000	
$\tau_{00, \text{Exp}}$		0.001	
N_{Part}		38	
N_{Exp}		24	
ICC_{Part}		0.000	
ICC_{Exp}		0.007	
Observations		1413	
R^2 / Ω_0^2		.026 / .025	

As it can be seen in Table 5, encoding of qualified nouns (regardless of emotional type) was found to be more difficult compared to bare nouns ($M = 457$, $SD = 162$). We did not find effects of information load or emotional type for the information conditions (see Figure 2).

Table 5. Means and results of contrasts with bare condition for region after the noun

	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
Emotional/High load	505	262	3.45	1392	<.001
Non-Emotional/High load	510	308	2.80	1387	.003
Emotional/Mid load	547	299	2.36	1389	.009
Non-Emotional/Mid load	567	325	3.48	1393	<.001

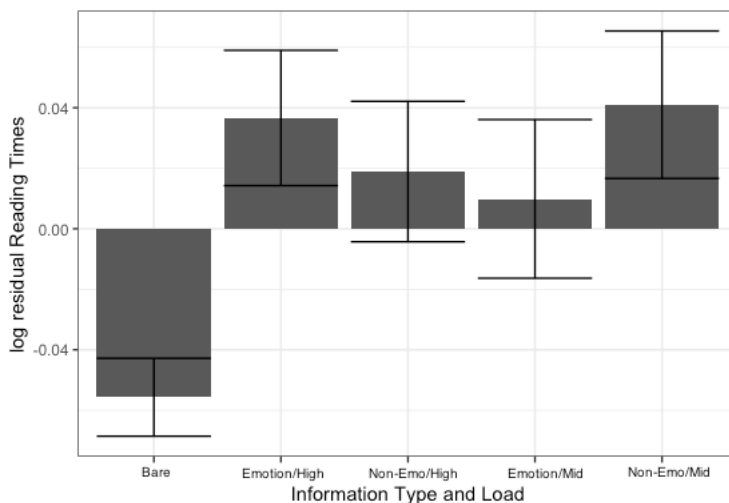


Figure 2. Reading times for bare nouns and qualified (emotionally or non-emotionally) nouns in mid or high load conditions at the region after the NP

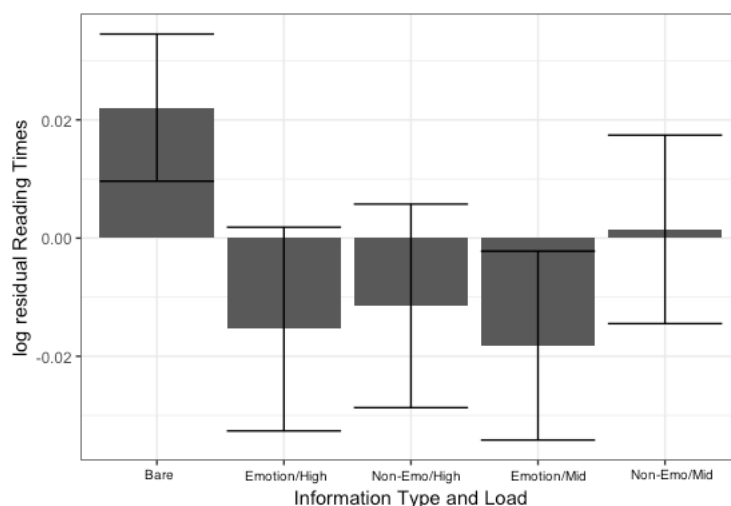
Reading times for the verb and the word after the verb

We did not find effects at the region of the verb (e.g. *awarded*), however, in line with Hofmeister's study (2011), the analysis revealed processing effects of information type at the region after the verb (e.g. *with*, see Table 6). We predicted that (emotionally) qualified nouns lead to faster retrieval (Hofmeister, 2011), hence we used one-tailed t-tests for comparisons.

Both conditions with emotional information (mid or high load) led to faster retrieval. Contrasts (with one-tailed t-tests) revealed that participants read faster at the region after the verb when there was one emotional adjective (mid load: $M = 456$, $SD = 169$; $t(1409) = 1.89$, $p = 0.029$), or one emotional and one non-emotional adjective (high load: $M = 435$, $SD = 168$; $t(1406) = 1.95$, $p = 0.025$) qualifying the noun rather than when the noun was presented bare ($M = 466$, $SD = 184$). Both non-emotional conditions (mid load: $M = 468$, $SD = 183$; high load: $M = 438$, $SD = 171$) did not differ to any other conditions.

Table 6. LMM coefficients and effects of information type (no information, emotional, non-emotional) and information load (either one or two adjectives) on reading times at the region after a verb, VP+1

	Residuals		
	<i>B</i>	<i>CI</i>	<i>p</i>
Fixed parts			
(Intercept)	0.02	-0.01–0.06	.142
Emotional/High load	-0.04	-0.08–0.00	.059
Non-Emotional/High load	-0.03	-0.07–0.01	.103
Emotional/Mid load	-0.04	-0.08–0.00	.052
Non-Emotional/Mid load	-0.02	-0.06–0.02	.298
Random parts			
σ^2		0.066	
$\tau_{00, \text{Part}}$		0.000	
$\tau_{00, \text{Exp}}$		0.003	
N_{Part}		69	
N_{Exp}		24	
ICC_{Part}		0.000	
ICC_{Exp}		0.044	
Observations		1432	
R^2 / Ω_0^2		.060 / .057	

**Figure 3.** Reading times for bare nouns, and qualified (emotionally or non-emotionally) nouns in mid or high load conditions at the region after the VP

Discussion

The current study was set up to investigate whether mental representations that are qualified with information, specifically of an emotional type, have a processing benefit over bare representations or non-emotionally qualified representations. We found evidence that qualified representations needed longer to

be build-up, but that emotionally qualified entities have a processing benefit over non-qualified entities.

For the head noun, we found that reading times were longer for emotionally qualified nouns, but only when two adjectives preceded the noun (rather than only one). This finding shows that complexity effects arise earlier for emotionally qualified nouns (compared to non-emotionally qualified nouns), and that the combination of emotional and non-emotional information coincides with even more complex encoding processes. We believe that the combination of those two types of information is rather unusual and hence, unexpected, leading to longer reading times. Moreover, it could be suggested that complex but non-emotional information is perceived as rather irrelevant so processing efforts are reduced. In contrast, readers attend to (Herbert et al. 2008; Kanske & Kotz, 2007; Kensinger, & Corkin, 2003) and are sensitive to the emotional status of the (complex) emotional information, which could be relevant later in the text (as it might help establishing coherence or explain later events (Zwaan, 1999; Kneepkens & Zwaan, 1995) and hence they need longer for the encoding process. So far, findings are in line with Hofmeister's notion (2011) about complexity effects. Readers needed longer to build up representations of more complex nouns. In addition, we found evidence that emotional pieces of information enhance this complexity effect and hence, they slow encoding processes.

The experiment replicated the findings of Hofmeister (2011) at the region after the noun-phrase. Results show that nouns preceded by qualifiers need longer to be processed and encoded (as indicated by reading times at the region after the noun phrase). In these cases, more information has to be processed, stored, and associatively linked in memory. Therefore, readers need longer time to build up representations and place the noun into the richer context (Hofmeister, 2011). However, results did not reveal differences between emotional and non-emotional information in the encoding stage. Emotional features did not facilitate or inhibit encoding processes, which means that readers were able to build up mental representations at a similar pace regardless of their emotional status. Hence, at the encoding stage, information load (i.e. the richness and specificity of a representation) does affect reading times so that it is more difficult to establish mental representations when entities are linked to more feature associations. These findings are in line with those of Hofmeister (2011). We did not find effects of the experimental manipulations (of emotional type or information load) for this region, however, we also analysed the region of the head noun where effects of both were evident.

In addition to the region around the noun phrase, we focused on the region around the verb phrase, at which retrieval effects are predicted to be found (e.g. from cue-based retrieval models, Van Dyke & Lewis, 2003), because the extraction site for the clefted element comes immediately after the verb. We expected signs of a facilitated retrieval when the to-be-retrieved noun previously occurred in a conceptually rich context (qualified by adjectives, e.g. *the English writer*). Similar to Hofmeister (2011), we argued that rich representations should be easier to recall for the reason that they are more salient in memory due to a broader network of associations linked to the target. Moreover, we suggested that more information helps to distinguish different representations within the sentence and that therefore the target can be identified more easily (Hofmeister, 2011).

Our study found evidence that emotional information in particular affects retrieval processes. Retrieval rates differed at the word that followed the verb. Differences were evident between emotionally charged representations and non-qualified representations and retrieval times were faster for entities that were qualified by emotional information. These effects suggest a special role of emotional information during processing.

The differences between emotionally charged and bare representations indicate that, not only does the amount of information itself play a role in establishing mental representations (as shown by Hofmeister in 2011), but that also the type of information is relevant. Hofmeister (2011) argued that more qualified, richer representations lead to the easier retrieval. However, we could only find a difference in retrieval rates between bare and emotional representations. We assume that, in line with cue-based models, a high number of features can help retrieval processes as representations become more specific and more "unique" (Hofmeister, 2011). However, emotional information might boost this effect because of its saliency (i.e. readers' focus on emotional information (Herbert et al., 2008; Kanske & Kotz, 2007; Kensinger & Corkin, 2003), its special role in processing, and its relevance for finding coherence within the text (Vega et al.,

1996; Kneepkens & Zwaan, 1995). These facts may explain why we only found differences in retrieval times between emotional and bare representations.

Furthermore, we did not find differences between sentences including one or two adjectives for this (retrieval) region showing that processing was not affected by the additional (non-emotional) adjective, which is in conflict with studies that the effects of emotions are attenuated with the increased processing load (Erk et al., 2007). Future studies should further investigate effects of information complexity on retrieval and whether there is a complexity threshold above which additional information does not lead to processing differences. Also, our emotion words were of positive and negative nature, however, there are studies highlighting differences regarding empathic engagement with positive and negative emotions and processing between them (Kidd & Castano, 2013; Altmann, Bohrn, Lubrich, Menninghaus, & Jacobs, 2012; Keen, 2006). Further research has to be done to account for the full range of emotions and their complexity to explain their impact on processing in more detail.

Conclusion

We found processing effects based on information load and the emotional value of information. In line with the study by Hofmeister (2011), effects were evident at encoding, when a mental representation of an either rich or bare noun phrase had to be constructed. Reading times for rich representations were slower as more information led to more complex integration processes. Moreover, we also found retrieval effects indicating that more complex representations, specifically those including emotional characteristics, led to a better (faster) recall. In our study, bare representations took longer recall than emotionally qualified representations. Our results emphasise the prominent role of emotions in comprehension. Emotions are linked to the saliency of a representation, most likely because of their role in establishing global coherence in a text, and so emotionality plays an important role during processing.

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